RH systems

SF_6 Analyzer 973

Operation Manual
Model 973-SF_6
V3.0

RH Systems, LLC
3416 Vista Alameda NE
Albuquerque, NM 87113 USA
+1 505 856 5766 Phone
+1 866 891 3399 Fax
info@rhs.com
www.rhs.com

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General

This manual explains the function of the 973- SF_6 Analyzer with and without the SO_2 option.
Throughout this manual the instrument will be called 973.
This manual refers to instrument software versions 110525a and higher.

Should the 973 be used in any other way than that described in this user's manual, or outside the limits described, the built-in safety protection of the instrument may be compromised.

Vol SF6 % All descriptions in ***bold italic*** are related to the text on the front panel, the display and the back panel of the 973.

If you wish to use the instrument as quickly as possible, we recommend reading the chapters **Initial Setup** (page 11) and **Measurement** (page 19). Standard use of the instrument is explained in these two chapters.

Short Description

Reliable Measurements in SF_6

The 973 was specifically designed for measurement of humidity, SF_6 purity and SO_2 concentration in gas insulated switchgear systems. Humidity measurement data is displayed in ppm_v, ppm_w and Dew/Frost Point. SF_6 purity measurement is displayed directly in % Volume SF_6. Both the humidity and purity measurements utilize accurate and reliable condensation techniques. SO_2 concentration is measured with an electrochemical cell with results displayed in ppm_v.

Gas Recovery and Pressure Measurement

The 973 is equipped with a gas recovery system that stores the sampled gas during the measurement process in its internal storage tank. After completion of the measurement, the stored gas is automatically pumped back into the original compartment or into another vessel. The compartment pressure is also measured.

Easy, Automated Measurement

The 973 is equipped with a user configurable full color active matrix LCD with integrated touch screen. The 973 may be configured for measurement of Humidity and % Volume SF_6 with either automatic or manually initiated Pump Back. Using the bi-directional RS-232 communications port, all measurement data may be easily transferred to a computer.

Calibration

Users can easily check the 973 calibration at any time using the built-in Ice Test function, providing instant verification of system accuracy and integrity.

Connect and Go

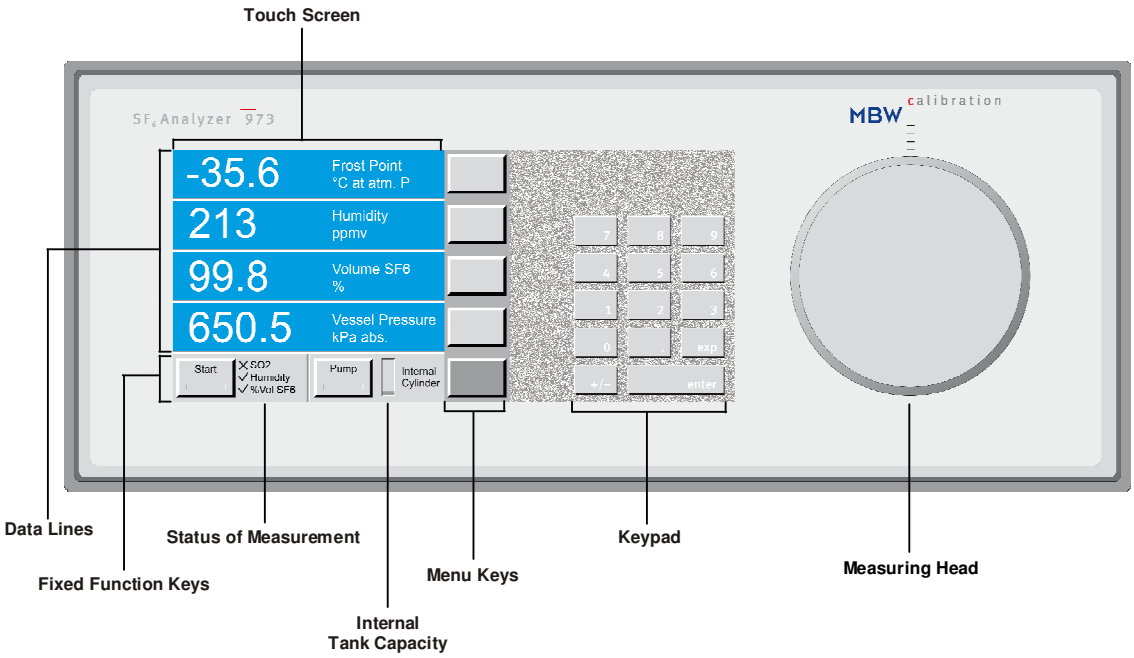
The system is supplied ready for immediate use.

973-SF_6 with Standard Accessories

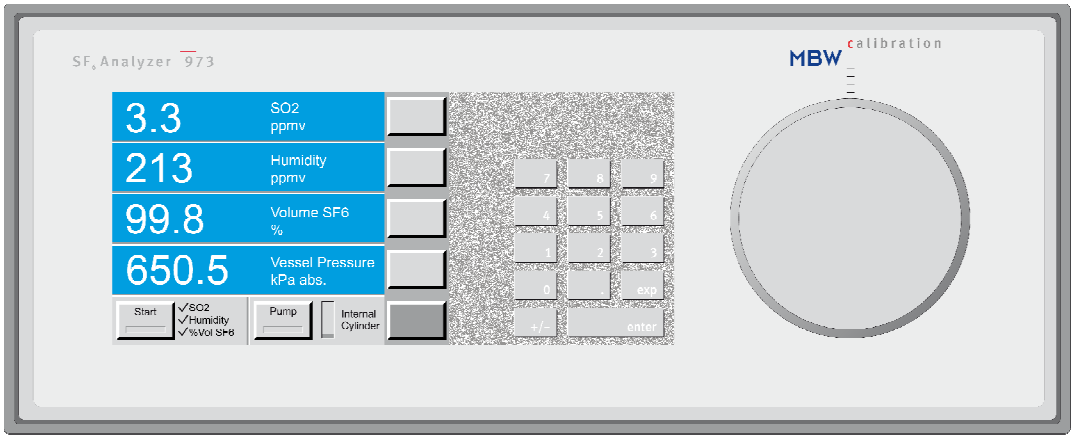
Transport Case
6m Stainless Steel armored PTFE tubing
DILO coupling DN20 and DN8
3 m RS-232 cable incl. USB adapter with USB cable
3 m power cable
Operation Manual
CD-ROM

Operation

Front Panel without SO_2 Option



Front Panel with SO_2 Option



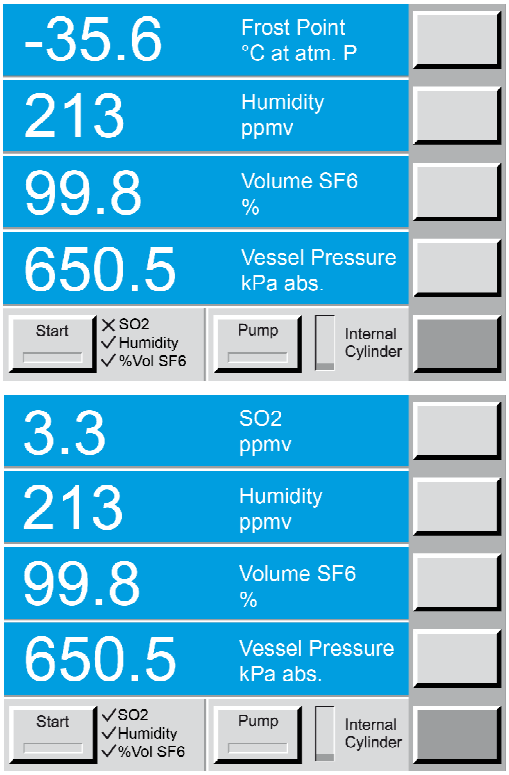
LCD Display with Touch Panel

The 973 utilizes a full color active matrix liquid crystal display with an integral touch panel. It has a high contrast ratio and a wide viewing angle for easy readability. Data is displayed in large, easy to read fonts. Using the on screen function and menu keys, you can easily configure each line of the display and navigate the menus.

Versions equipped with the SO_2 option will have alternative display and data line formats. Please refer to page 21 for further information on the measurement of SO_2 concentration.

Data Lines

The first four lines of the display are for numeric representation of the measured data. We refer to those first four lines as Data Lines. Numeric data lines contain the value to the left, with the parameter description and units to the right. The displayed parameters and units can be changed, but after a restart of the instrument, the values will be reset to the stored standard configuration.



Data Line 1

This line displays the measured Dew/Frost Point. The unit is °C related to atmospheric pressure.

In the standard configuration, instruments equipped with the SO_2 option show the SO_2 concentration expressed in ppm_v. The standard SO_2 configuration is shown on the second display.

Data Line 2

This line displays the humidity content in either ppm_v (parts per million by volume) or ppm_w (parts per million by weight). This ppm_v unit is pressure independent.

Data Line 3

This line displays the purity in % Volume SF_6.

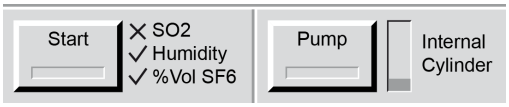
Data Line 4

This line indicates the current pressure of the gas compartment. The unit is kilo Pascal absolute pressure.

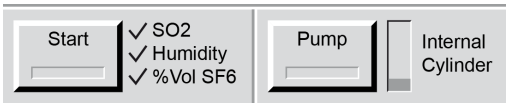
The data lines indicating the measured Humidity and SO_2 concentrations as well as the % Volume SF_6 will only be displayed after completion of the measurement. During the measurement only the current gas pressure of the measured compartment is indicated.

Fixed Function Keys and Status Line

Without SO_2 Option

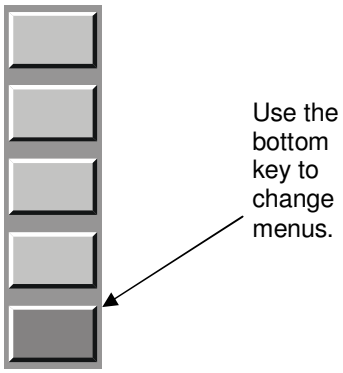


With SO_2 Option



The bottom line of the display contains two fixed function keys.The measurement process is started by pressing the ***Start*** button. With the ***Pump*** button, pump back of stored gas in the internal cylinder can be activated manually. These function keys are not changeable and are always available. Additionally this line contains the status indication, which indicates the current operation mode. The level indicator of the internal tank indicates the current storage capacity. A 973 without the SO_2 option will display an ***X*** next to ***SO_2*** to indicate that the measurement of SO_2 concentration is not available.

Menu Keys



To the right side of the display is a column of menu keys. Each of these keys changes function as needed.

Notice that the bottom key in this column is different from the rest. The bottom key is used to cycle the upper keys through the various menu options. The text on the bottom key changes to indicate the currently selected menu option. The text of the upper keys change based on the functions available in the menu.

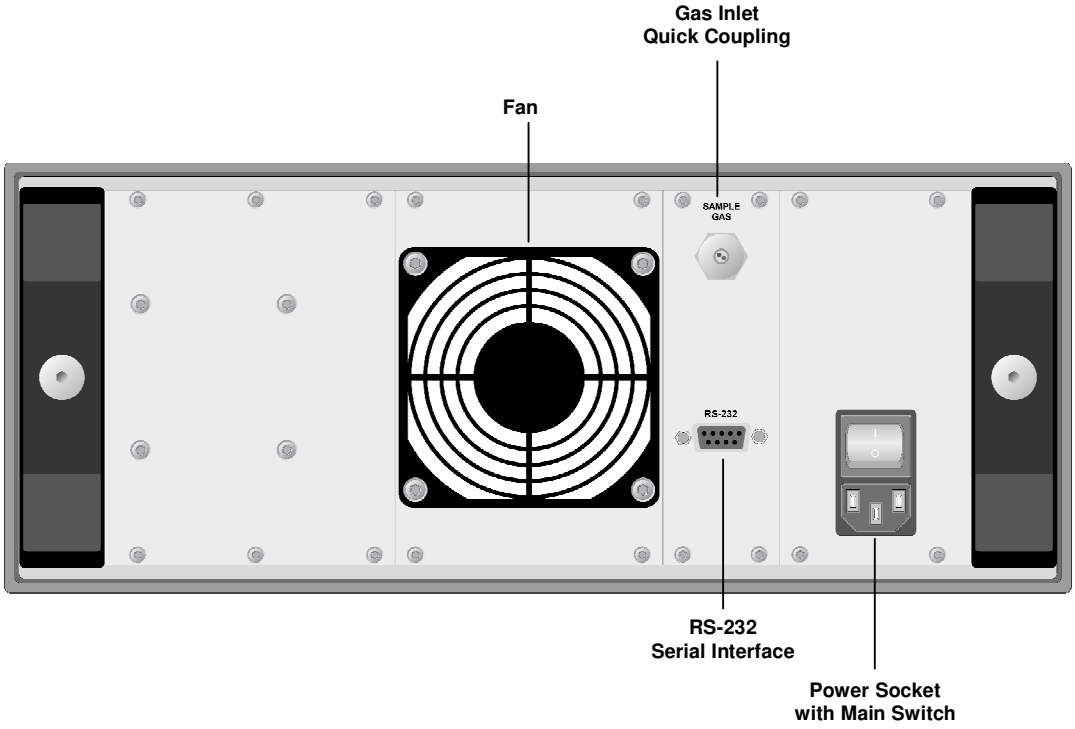
Keypad

The keypad is used for entering data into the 973. For normal operation it is rarely used.

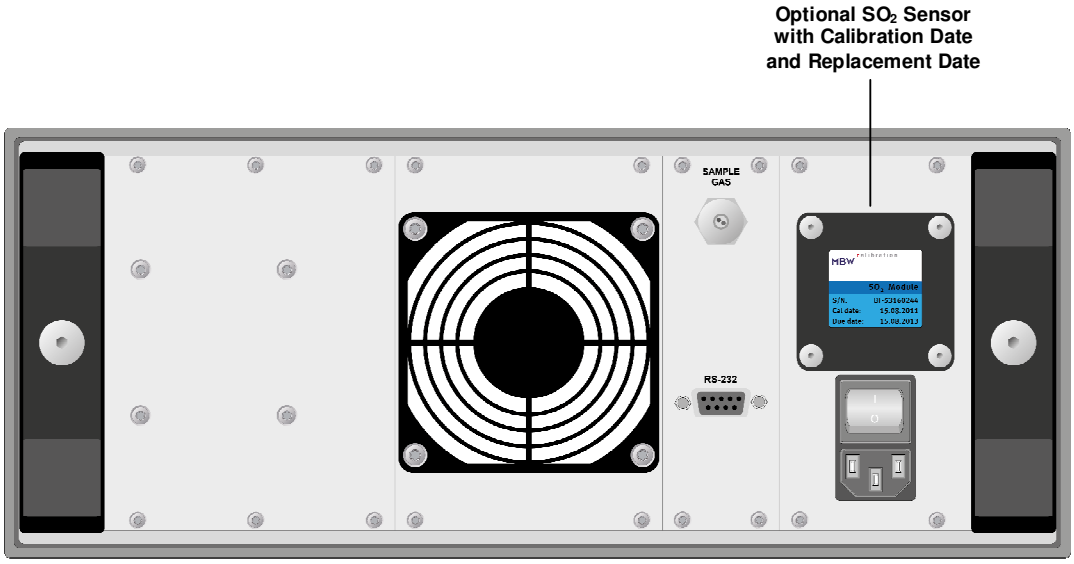
Carrying Handle

To adjust the position of the carrying handle, press the buttons on both sides to unlock it before rotating. Release the buttons when the desired position is found.

Back Panel without SO_2 Option



Back Panel with SO_2 Option



Power Connection

The AC power cord is connected to the power socket on the instrument back panel. The power socket also includes the power switch. The power supply voltage is 100-120 VAC / 200-240 VAC at 50 to 60Hz. The power supply is internally fused and will automatically switch off in case of an overload. To restart the power supply, the instrument main switch must be switched to ***0*** and ***I*** again.

SO_2 Module

When fitted, the SO_2 module is mounted to the back panel of the 973 which allows the SO_2 sensor to be easily replaced by the user. The sensor has to be replaced every two years. The calibration and replacement dates are indicated on the SO_2 Module.

Gas Inlet Quick Coupling

The sampling line is connected to the sample gas inlet. If the instrument is not in use the inlet should be protected with the blue cover.

RS-232 Serial Interface Connector

The RS-232 connector is used when connecting the 973 to a computer. Use the supplied 9 pin 1:1 cable to connect the 973 to a desktop or laptop computer. This cable has a male connector on one end and a female connector on the other end. It is most often referred to as a serial extension cable.

Fan

When the 973 is switched on, the cooling fan always runs independent of the ambient and instrument temperatures.

Initial Setup

Preparation

The 973 needs a source of normal AC power. The label on the back panel indicates the acceptable input voltage range. The instrument has been designed to work with a power range between 100-120 VAC / 200-240 VAC at 50 to 60 Hz. This normally covers all usual AC line voltages.

Electrical Connection

The power socket and the 973 main power switch are on the back panel of the instrument. Use the provided power cable to connect the instrument to the AC power.

Start the instrument by turning on the power switch. The display of the 973 comes up immediately following the processor's boot phase. The boot phase may take several seconds to complete.

Connection of the Serial Interface

If you intend to transfer the measured data to a computer, connect the serial cable between the instruement and the computer.

If your computer is equipped with a USB interface, you can use the provided RS-232/USB converter. You will find the drivers on the CD. The installation and data collection will be explained in the chapter ‘Data Collection in Excel’ on page25.

SF_6 Gas Connection

The quick coupling on the instrument side of the sampling tube must be connected to the ***SAMPLE GAS*** inlet.

Note:
To prevent contamination, the blue cover caps of the instrument and sampling tube should always be installed when the instrument is not in use.

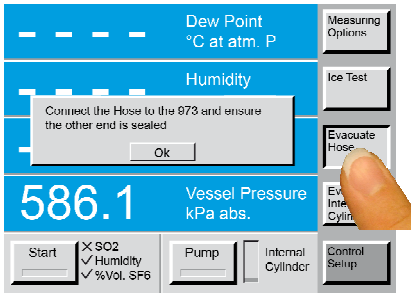
The standard accessories of the 973 include a DN8 and a DN20 DILO coupling.

Evacuate the Sampling Tube

The sampling tube must be evacuated before the first initial measurement is started. Once initially evacuated, there is no need to re-evacuate the hose, even when moving the connection to the next compartment.

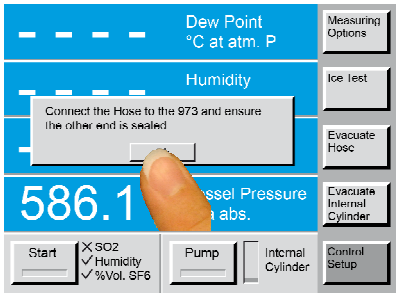
Make sure that a DILO coupling DN8 or DN20 is properly installed on the sampling tube, but do not connect the DILO coupling to anything else at this time. Since the DILO couplings are self-sealing, the sampling tube is sealed.

Ensure that the other end of the sampling tube is properly connected to the 973.

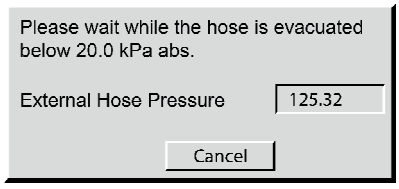


Press the lower right key in order to select the ***Control Setup*** menu. ***Control Setup*** appears on the key, while on the upper keys the available menu options are indicated.

Press the ***Evacuate Hose*** key.



With the sampling tube correctly connected, press the ***Ok*** key in order to start the evacuation process.



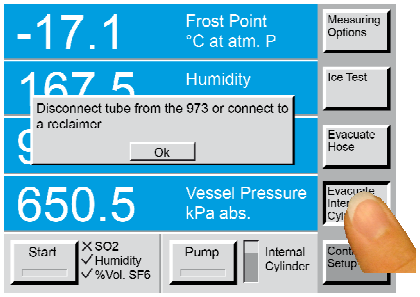
After the evacuation has started, the next window indicates the decreasing pressure of the sampling gas tube while evacuating.

After reaching the set residual pressure of 20 kPa, the evacuation process is stopped automatically and the window closes. The instrument and the sampling tube are now ready for measurement.

By pressing the ***Cancel*** key during evacuation, the process can be manually stopped.

Evacuation of the Internal Cylinder

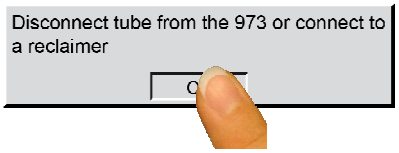
If the content of the internal cylinder is unknown, or contaminated SF_6 gas is in the storage tank, the internal storage cylinder can be evacuated.



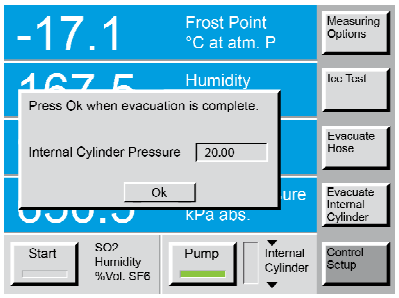
Press the ***Evacuate Internal Cylinder*** key in the ***Control Setup*** menu.

The dialogue box requests you to remove the sampling gas tube or connect an SF_6 reclaimer to the 973.

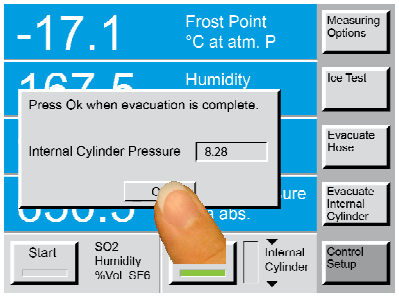
Disconnect the quick coupling from the ***SAMPLE GAS*** inlet or connect the instrument to an SF_6 reclaimer.



Press the ***Ok*** button to start the internal cylinder evacuation.



The dialogue box indicates the current internal cylinder pressure during evacuation. After evacuating below 20 kPa residual pressure, the internal pump automatically stops. The evacuation process can be stopped by pressing the ***Ok*** button.



If the 973 is connected to an external reclaimer, evacuation can be continued with the reclaimer until the desired residual pressure is reached. By pressing the ***Ok*** button, the evacuation process can be stopped.

SF_6 Gas Connection to the Compartment

If the sampling tube was properly evacuated before the first measurement, it is now ready to connect to the gas compartment. When moving the connection from compartment to compartment, there is no need to re-evacuate.

Remove the dust caps from fittings, check both threads are clean, and carefully screw on the fitting ensuring a good seal is made.

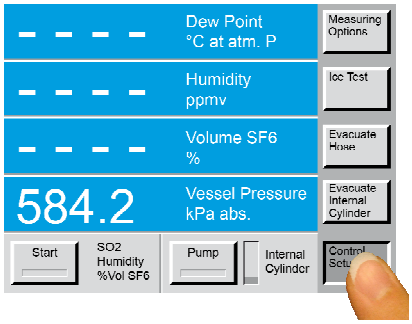
Measurement Options

Navigating the Menus

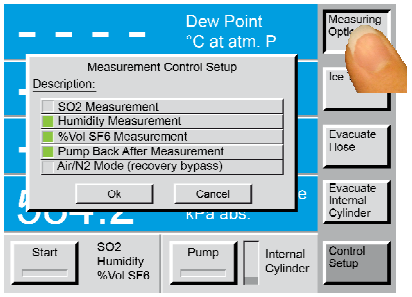
The various menus of the right column of keys are navigated by using the key in the lower right corner of the touch screen. Each time you press the lower right key, a new menu appears on the keys directly above it. The menu is circular, meaning that once you go past the last menu, the first one appears again and the process starts over. You can use the ***+/-*** key on the keypad to move backward through the menus. Use the ***Enter*** key to clear the menu.

Selecting the Measurement Options

With the measuring options you can select either the Humidity Measurement, % Volume SF_6 measurement, or both. In addition, you can select Automatic Pump Back of the stored gas after the termination of the measurement. With the standard 973-SF_6 configuration, humidity measurement,% volume SF_6 measurement and automatic pump back are selected. This configuration can be changed. However, after restarting the instrument, it will be set back to the standard configuration.

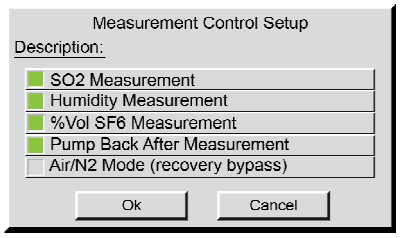


Press the lower right menu key once to select the ***Control Setup*** menu. ***Control Setup*** appears on the key while the keys above change to available menu options. Notice that the top key indicates ***Measuring Options***.



Press the ***Measuring Options*** menu key at the top right corner of the screen. The ***Measurement Control Setup*** window appears.

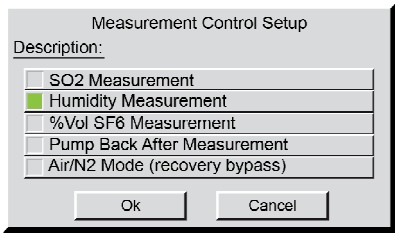
This standard 973 configuration without the SO_2 module is ***Humidity Measurement***, ***% Vol SF6 Measurement***, and ***Pump Back After Measurement.***



For the 973 equipped with the SO_2 option, the standard configuration is **SO2 *Measurement, Humidity Measurement***, ***% Vol SF6 Measurement***, and ***Pump Back After Measurement***

Measuring Mode Examples

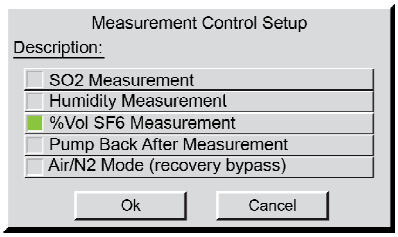
The examples shown include the measuring options for the 973 when equipped with the SO_2 option. When there is no SO_2 module fitted to the instrument, the ***SO2 Measurement*** button is disabled and cannot be selected.



For the purpose of this example, select only ***Humidity Measurement***, and disable ***SO2 Measurement, % Vol SF6 Measurement*** and ***Pump Back After Measurement***.

Now press the ***Ok*** button.

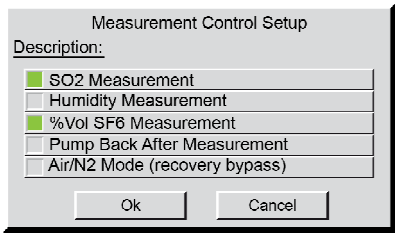
With this configuration, only humidity measurement is performed. The sample gas is collected and held in the internal cylinder and not automatically pumped back.



For the purpose of this example, select only ***% Vol SF6 Measurement***, and disable ***SO2 Measurement, Humidity Measurement*** and ***Pump Back After Measurement***.

Now press the ***Ok*** button.

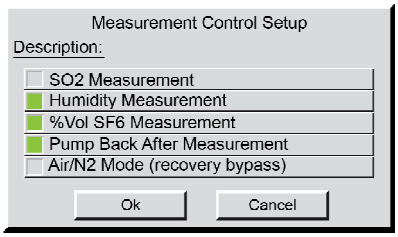
With this configuration, only the SF_6 purity measurement is performed. The sample gas is collected and held in the internal cylinder and not automatically pumped back.



For the purpose of this example, select only ***SO2 Measurement*** and ***% Vol SF6 Measurement***, and disable ***Humidity Measurement*** and ***Pump Back After Measurement***.

Now press the ***Ok*** button.

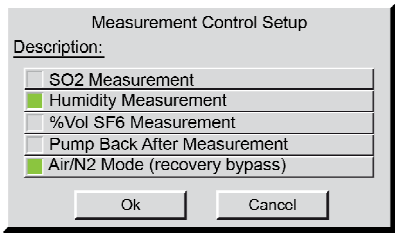
With this configuration, SO_2 measurement and % volume SF_6 measurement will be performed without humidity measurement and automatic pump back.



For the purpose of this example, select ***Humidity Measurement***, ***% Vol SF6 Measurement*** and ***Pump Back After Measurement.***

Now press the ***Ok*** button.

With this configuration, humidity and SF6 purity measurements will be performed, followed by automatic pump back of the sample gas. This is the standard 973 configuration.



In this example, select the ***Humidity Measurement*** and ***Air/N2 Mode***.

Now press the ***Ok*** button.

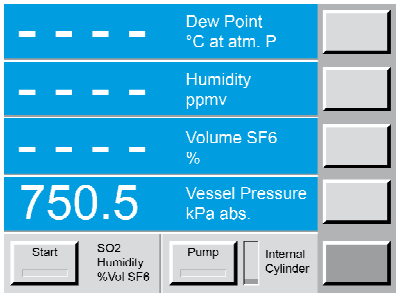
With this configuration, only the humidity measurement is performed. The measured gas will be pumped to atmosphere rather than being stored in the internal storage cylinder. This mode is only used for the measurement of air or nitrogen (N_2) and should never be used for measurement of SF6 gas.

Measurement

Measurement without SO_2 Option

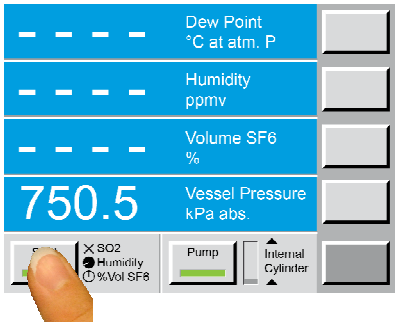
This section describes the measurement sequence for the 973-SF_6 Analyzer without the SO_2 option. Please refer to page 21 for the equivalent procedure for instruments equipped with the SO_2 option.

If you intend to collect the measurement data automatically, please install the Excel Protocol sheet, as described on page 25, before the start of the measurement.

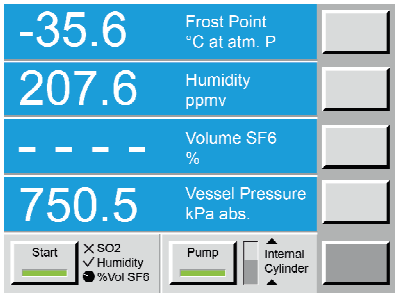


As soon as the 973 is connected to the gas compartment, the current vessel pressure is indicated. The standard configuration for the pressure unit is kPa absolute. The input pressure range is 100 – 1'000 kPa abs.

When the instrument is switched on, the standard measuring mode with ***Humidity Measurement***, ***% Volume SF_6 Measurement*** and ***Pump Back After Measurement*** is activated.



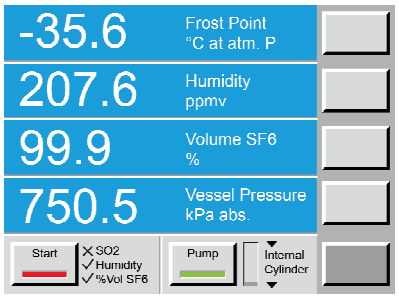
Press the ***Start*** button. The ***Start*** button and the ***Pump*** button turn green. Because the SO_2 measurement is disabled, an X appears next to ***SO2***. The pump starts and the humidity clock, located next to the ***Start*** button, begins to spin. During the measurement, SF_6 gas flows from the gas compartment, through the hose, through the measuring head, and into the internal storage cylinder. The internal cylinder trend arrows and level indicator show the rising pressure in the internal storage tank.



After completion of the humidity measurement, the spinning clock stops. Both the measured Frost/Dew Point and the humidity content in ppm_v are displayed.

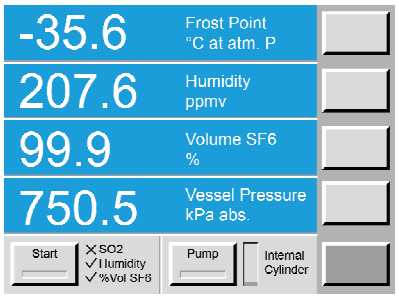
Then the % Volume SF_6 measurement starts and the corresponding clock begins to spin.

The internal cylinder trend arrows and level indicator show the rising pressure in the internal storage tank.



After completion of the % Volume SF_6 measurement, the spinning clock stops and the measured % Volume SF_6 is displayed.

Finally, the pump back starts and the trend arrows and level indicator show the decreasing pressure of the internal storage cylinder. The mirror is heated at the same time, indicated by the red ***Start*** key. During the heating phase the ***Start*** key is locked out.



At the completion of pump back, the measuring head pressure is reduced to 100 kPa abs (approximately atmospheric pressure). After stabilization of the displayed gas compartment pressure (approx. 5 seconds), the measurement results are now available on the data lines as well as on the serial interface for data transfer to the excel protocol (see page 26).

The measurement data for Humidity and % Volume SF_6 remain stored and displayed until the next measurement is started by pressing the ***Start*** button. The vessel pressure measurement always indicates the current pressure at the 973 sample gas input. After completion of the measurement, the gas compartment pressure remains properly indicated as long as the sampling tube is connected to the gas compartment.

After connection of the sampling tube to the next gas compartment, the next measurement can be started by pressing the ***Start*** button.

Termination of Measurement

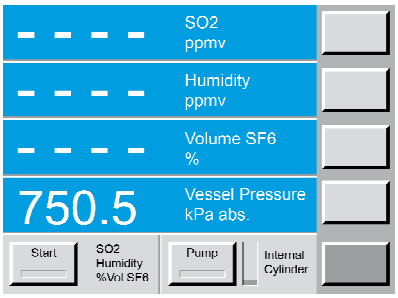
After completion of the measurements, disconnect the DILO coupling from the gas compartment and close it with the yellow screw cover. Then disconnect the quick coupling from the 973 and cover the gas inlet as well as the coupling of the tube with the blue caps. The last measured SF_6 remains in the sampling tube. A correctly closed sampling tube is protected from dust and ambient air.

If the measurement was stopped with a normal pump back sequence, 100 kPa abs. pressure (~0 kPa gauge) will remain in the internal storage cylinder. The instrument can now be correctly transported.

Measurement with SO_2 Option

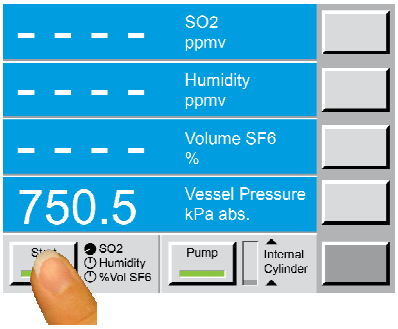
The section describes the measurement procedure for the 973-SF_6 Analyzers equipped with the SO_2 option. Refer to page 19 for equivalent procedures for instruments without the SO_2 option.

If you intend to collect the measurement data automatically, please install the Excel Protocol sheet, as described on page 25, before the start of the measurement.

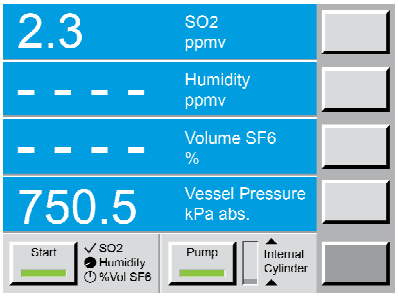


As soon as the 973 is connected to the gas compartment, the current vessel pressure is indicated. The standard configuration for the pressure unit is kPa absolute. The input pressure range is 100…1'000 kPa abs.

When the instrument is switched on, the standard measuring mode with ***SO_2 Measurement***, ***Humidity Measurement***, ***% Volume SF_6 Measurement*** and ***Pump Back After Measurement*** is activated.

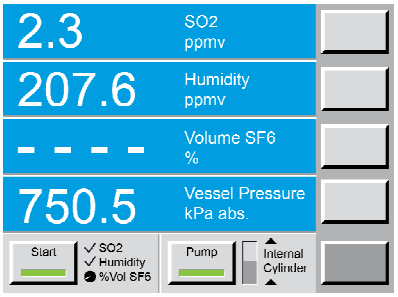


Press the ***Start*** button. The ***Start*** button and the ***Pump*** button turn green. The pump starts and the ***SO2*** clock, located next to the ***Start*** button, begins to spin. During the measurement, SF_6 gas flows from the gas compartment, through the hose, through the SO_2 module, and into the internal storage cylinder.



Once the SO_2 measurement is complete, the spinning clock stops and the measured SO_2 concentration is displayed.

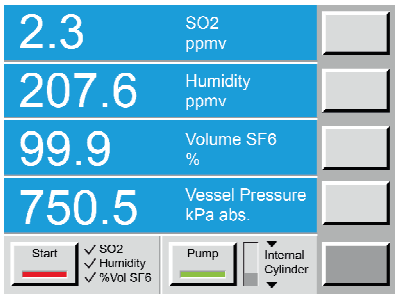
The 973 then automatically initiates humidity measurement. The spinning clock indicates that measurement is in progress. During humidity measurement, SF_6 gas flows from the gas compartment through the measurement head, and into the internal cylinder.



After completion of the humidity measurement, the spinning clock stops and the humidity content in ppm_v is displayed.

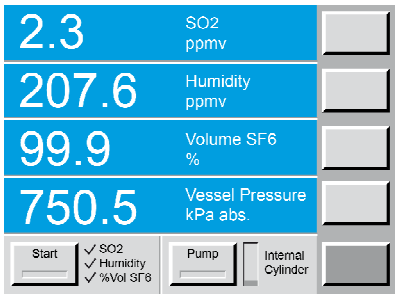
Then the % Volume SF_6 measurement starts and the corresponding clock begins to spin.

The internal cylinder trend arrows and level indicator show the rising pressure in the internal storage tank.



After completion of the % Volume SF_6 measurement, the spinning clock stops and the measured % Volume SF_6 is displayed.

Finally, the pump back starts and the trend arrows and level indicator show the decreasing pressure of the internal storage cylinder. The mirror is heated at the same time, indicated by the red ***Start*** key. During the heating phase the ***Start*** key is locked out.



At the completion of pump back, the measuring head pressure is reduced to 100 kPa abs (approximately atmospheric pressure). After stabilization of the displayed gas compartment pressure (approx. 5 seconds), the measurement results are now available on the data lines as well as on the serial interface for data transfer to the excel protocol (see page 26).

The measurement data for SO_2, Humidity and % Volume SF_6 remain stored and displayed until the next measurement is started by pressing the ***Start*** button. The vessel pressure measurement always indicates the current pressure at the 973 sample gas input. After completion of the measurement, the gas compartment pressure remains properly indicated as long as the sampling tube is connected to the gas compartment.

After connection of the sampling tube to the next gas compartment, the next measurement can be started by pressing the ***Start*** button.

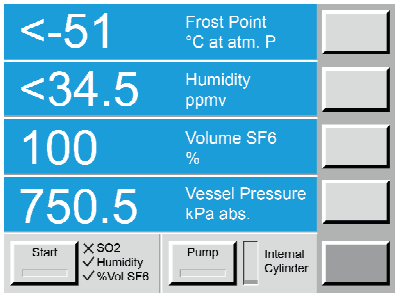
Termination of Measurement

After completion of the measurements, disconnect the DILO coupling from the gas compartment and close it with the yellow screw cover. Then disconnect the quick coupling from the 973 and cover the gas inlet as well as the coupling of the tube with the blue caps. The last measured SF_6 remains in the sampling tube. A correctly closed sampling tube is protected from dust and ambient air.

If the measurement was stopped with a normal pump back sequence, 100 kPa abs. pressure (~0 kPa gauge) will remain in the internal storage cylinder. The instrument can now be correctly transported.

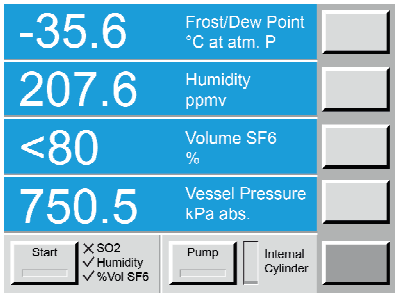
Measuring Range Limitations

The lower measuring limits of the 973 are approximately 40 ppm_v for Humidity and 80% for Volume SF_6. If the measured value for Humidity or % Volume SF_6 is below this measuring limit, the instrument indicates these conditions as follows:



If the measured value of Humidity is below the measuring limit of the 973, the display shows a 'smaller than' symbol **<** followed by the lower limit humidity value.

This indicates that the actual measured humidity value is below the displayed value, and below the measuring limit of the instrument.

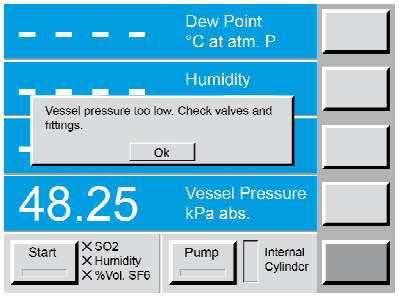


If the measured value of % Volume SF_6 is below the measuring limit of the 973, the display shows ***< 80***.

This indicates that the actual % Volume SF_6 value is below the measuring limit of the instrument.

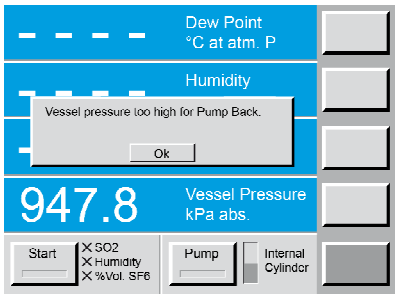
If the instrument indicates a reading of ***>100*** for % Volume SF_6, service or calibration may be needed. Please contact the manufacturer or your local supplier for further information.

Alarm Messages



If the gas compartment pressure is too low, or if the DILO coupling is not correctly connected to the gas compartment an underpressure occurs in the sampling tube and the measurement stops automatically. The 973 displays that the pressure is too low.

Make sure the sampling tube is correctly connected on both sides and the minimal gas pressure of at least 100 kPa absolute is available.



If the gas compartment pressure is too high to allow the pump back, the 973 turns the pump off automatically and indicates that the compartment pressure is too high. The maximum pump back pressure is 900 kPa abs.

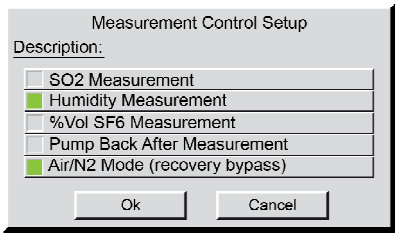
Connect the 973 to a gas compartment or waste cylinder with a lower pressure to pump back the stored SF_6.

Measurement Aborted

If the measurement is aborted due to low or high pressure conditions, the 973 will heat up the mirror, restore the measuring head pressure to 100 kPa abs (approximately atmospheric pressure), and stop. Pump back of the stored gas in the internal cylinder can be started by pressing the ***Pump*** key.

Measurement of Air or Nitrogen (N_2)

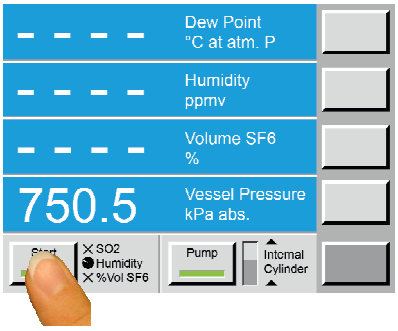
The 973 is equipped with a measuring mode for air or nitrogen. The measured air/nitrogen is not stored in the internal cylinder and will be pumped to atmosphere through a small vent point internal to the 973.



Activate the Air/N_2 measurement mode by selecting ***Humidity Measurement*** and ***Air/N2 Mode*** in the ***Measuring Options*** Menu.

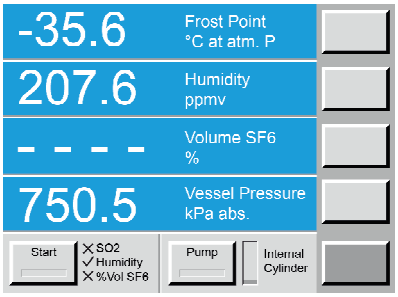
Press the ***Ok*** key.

In this measuring mode, only the Humidity Measurement is performed, without storing the gas in the internal cylinder.



Press ***Start***.

During measurement, the 973 will pump gas through the gas connection port, over the measuring head and through a vent to atmosphere.



Once the humdity value is stable, the instrument beeps and holds the measured value on the display.

Data Collection in Excel

RS-232 – USB Converter Installation

KeyspanUSA19hsWinV34.exe

On the CD-ROM 973-SF_6 you will find the drivers for the Keyspan RS-232 / USB Adapter.

Double click on:

KeyspanUSA19hsWinV34.exe

and follow the installations instructions. The program is stored by default in the folder **C:\Program\Keyspan\USB Serial Adapter**.

[You may also find the latest driver for this device at www.tripplite.com and search for USA-19HS]

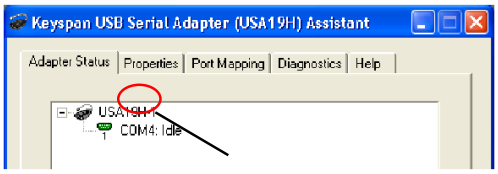
K19hasst.exe

After installation, you may plug the adapter into the USB port of your computer.

Locate the Keyspan Assistant in the default folder **C:\Program\Keyspan\USB Serial Adapter.** .

Double-click on:

K19hasst.exe or launch the **Keyspan Serial Assistant** from the Start menu.



COM Port Number 4

In the **Adapter Status** tab**,** the assistant will show you which COM Port the USB Adapter will use. You will need this COM Port number later since it will need to be entered into the Excel Protocol in the cell **Read Data From COM**.

KeyspanUSA19HforWindowsv34.pdf

After the installation, additional information regarding use of the adapter should be found in the following folder :

C:\Program\Keyspan\USB Serial Adapter\docs

Data Collection over RS-232 with the Excel Protocol

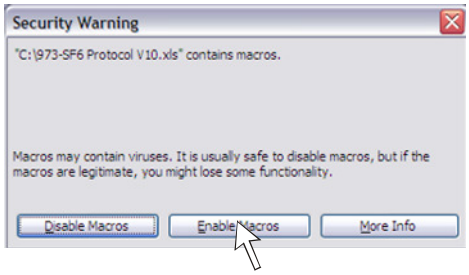
When the 973 is connected to a computer via the RS-232 connection, the measuring results may be transferred directly into the Excel Protocol.

973-SF6 Protocol V10

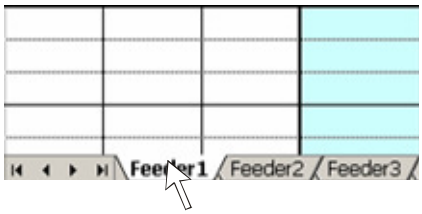
On the CD-ROM 973-SF_6 you will find the 973-SF6 protocol.

Double click on:

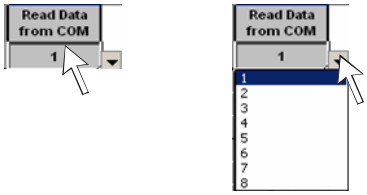
973-SF6 Protocol V10


Security Warning
"C:\973-SF6 Protocol V10.xls" contains macros.
Macros may contain viruses. It is usually safe to disable macros, but if the macros are legitimate, you might lose some functionality.
Disable Macros
Enable Macros
More Info

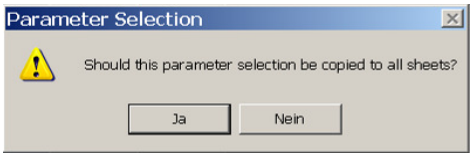
After opening the 973-SF6 protocol the safety warning may appear. Please select ***Enable Macros***.



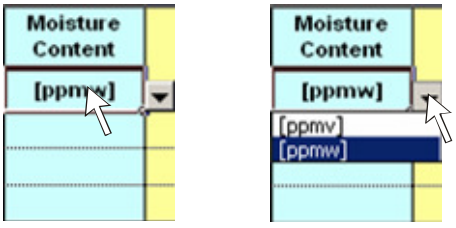
The protocol initially has only one worksheet named 'Feeder 1'. You may add additional sheets as required using the New Worksheet functions of Excel. Additional worksheets will be added with names such as 'Feeder 2', 'Feeder 3', and so on.



Click on the cell below the field **Read Data from COM**. An arrow appears on the right side. By clicking on the arrow the window for the input selections of the COM Port Number opens. If you use the Keyspan USB Adapter, you find the COM Port Number in the Keyspan USB Serial Adapter Assistant (see page 25).



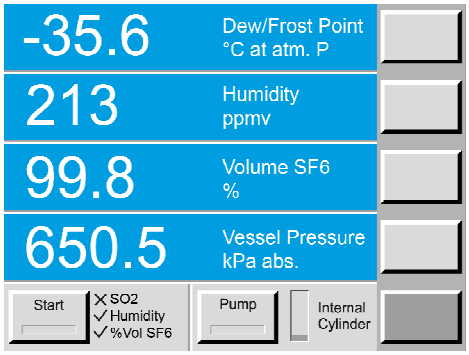
After input of the COM Port Number the window Parameter Selection opens, with which you can confirm whether your selection should apply to only this worksheet, or all worksheets (Feeder 1... n) in the file. Although not required, it is generally preferable to copy the parameter changes to all sheets.



In order to change the different units, click on the respective unit field. On the right side an arrow appears. By clicking on this arrow a selection window with the possible units opens. The selection of units of the Excel Protocol are independent of the display of the 973.

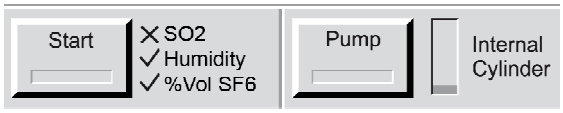
Feeder Bay	Gas Comp.	Phase
1	B0	R
1	B0	S
1	B0	T

Enter the gas compartment identification in the appropriate fields (the three leftmost columns).



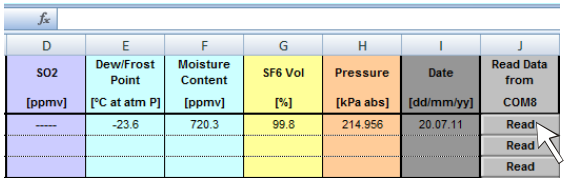
Use the **Start** button to initiate a measurement with the 973. After completion of a measurement, the measuring results for Humidity and % SF_6 (and SO_2 if your instrument is equipped with the SO_2 option) are available on the display and on the serial port.

The pressure value on the display indicates the current gas compartment pressure as long as the sampling tube is connected to the corresponding gas compartment. Data is now ready for transfer.

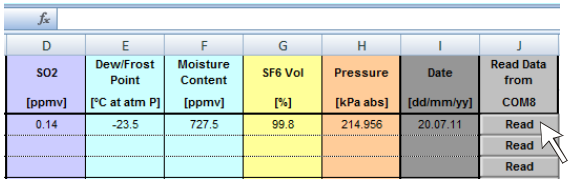


The measurement is finished if all selected modes are confirmed with a check mark and the red light of the start button expires after the end of the mirror heating phase.

If your instrument is not equipped with an SO_2 module then an X will remain next to ***SO2*** indicating that no SO_2 measurement took place. However, if your instrument is equipped with the SO_2 option, and that measurement mode was selected, a check mark will appear in front of ***SO2***.



D	E	F	G	H	I	J
SO2 [ppmv]	Dew/Frost Point [°C at atm P]	Moisture Content [ppmv]	SF6 Vol [%]	Pressure [kPa abs]	Date [dd/mm/yy]	Read Data from COM8
-----	-23.6	720.3	99.8	214.956	20.07.11	Read
						Read
						Read

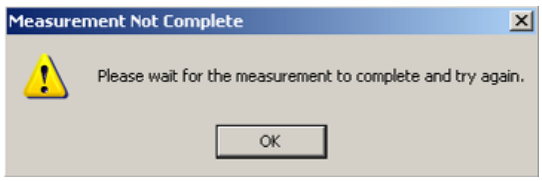


D	E	F	G	H	I	J
SO2 [ppmv]	Dew/Frost Point [°C at atm P]	Moisture Content [ppmv]	SF6 Vol [%]	Pressure [kPa abs]	Date [dd/mm/yy]	Read Data from COM8
0.14	-23.5	727.5	99.8	214.956	20.07.11	Read
						Read
						Read

By clicking the **Read** button the measured values for **Dew/Frost Point**, **Moisture Content, SF6 Vol** and **Pressure** are transferred into the corresponding cells. If your instrument is not equipped with an SO_2 module, the **SO2** line will simply remain empty. If you have the SO_2 option, then the SO_2 reading will also appear in its column
Additionally the **Date** is recorded. The value for the pressure measurement corresponds with the measured value at the moment when the **Read** button is pressed. The stored data for **Dew/Frost Point**, **Moisture Content** and **SF6 Vol** remain stored in the 973 until the next measurement is started.

Instrument ID:	973-SF6	Instrument S/N:	05-0714

The instrument type and serial number are automatically stored in the last line at the bottom of the page



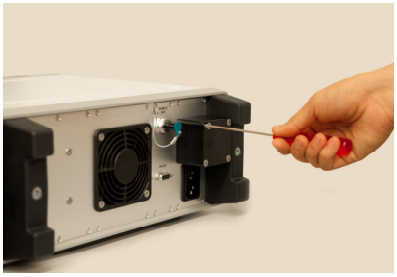
Note that data communication can be accomplished after completion of the measuring cycle. If the **Read** button is pressed during the measurement, a message appears which requests you to wait for completion of the measurement. If you see this message, just click **Ok** and wait for the measurement to complete, then press the corresponding **Read** button again.

SO_2 Module

The 973 internal SO_2 module provides the user with the capability to measure SO_2 concentration in SF_6 gas compartments. The module is conveniently mounted on the back panel of the instrument with the sample gas connections internally connected.

The module uses an electrochemical cell specifically for SO_2. The measurement cell is designed to provide accurate and stable results for two years in normal operation. Calibration checks can be peformed using gas standards with certified SO_2 concentration. Please contact the manufacturer or your local supplier for further information.

Back panel mounting means that the user can easily replace the measurement cell assembly. Replacement cell assemblies are readily available and are supplied pre-adjusted for direct installation into the 973. To replace the SO_2 cell, follow the procedure:



Contact us or your local supplier to obtain a replacement cell assembly.

Disconnect the 973 from gas or electrical connections and remove the four module screws.

Pull straight back to remove the existing SO_2 measurement cell assembly.

Install the replacement assembly making sure the sealing O-ring remains correctly located and the pins line up.

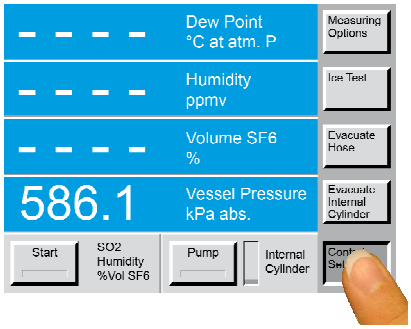
Replace the cover and screws.

Reconnect power and sample gas lines to continue measurement.

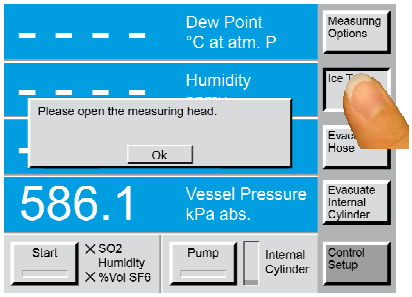
Test Functions

Ice Test

The measuring accuracy can be checked with a simple, built-in test. The test may be performed at any time, and is recommended if the results of your normal measurements do not correspond to expectations and an error is assumed with the instrument.



Press the lower right menu key once to select the ***Control Setup*** menu. ***Control Setup*** appears on the key while the keys above change to the available menu options. Notice that the second key from the top indicates ***Ice Test***.

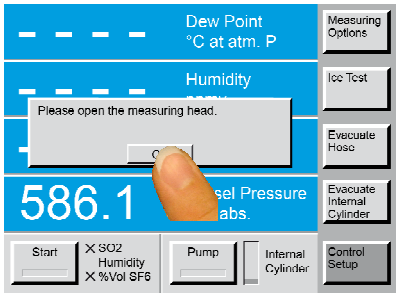


Press the ***Ice Test*** menu key. A window requests you open the measuring head.

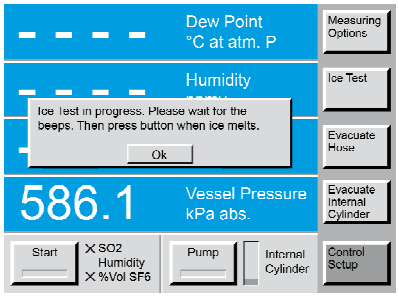
The measuring head of the 973 is located on the right side of the front panel. Remove the large tan cover screw by twisting it counter-clockwise (about 3 full turns).

More detailed removal/installation information is available beginning on page 42.

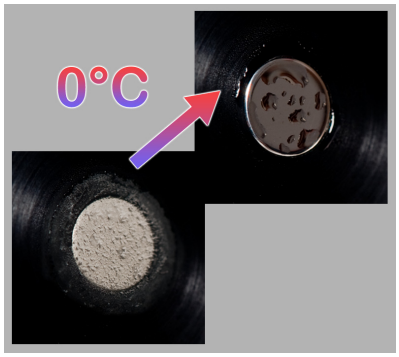
Once the screw cover has been removed, the black optical assembly (optical head) is now removed by pulling it straight toward you.The mirror is now visible and you are redy to perform the Ice Test.



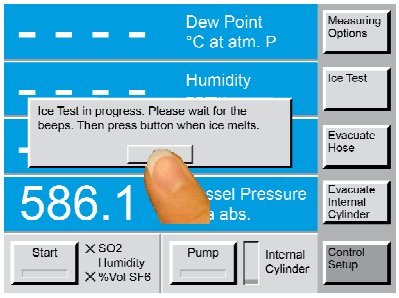
Confirm that you opened the measuring head and are ready for the Ice Test by pressing the ***Ok*** button. This starts the test immediately.



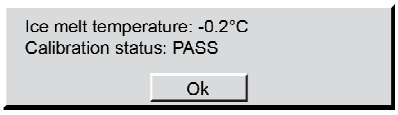
During the Ice Test, the mirror rapidly cools to approximately -30°C. Because the measuring head is open, humidity from the ambient air starts to condense on the mirror. This forms a frost layer on the mirror which can be strengthened if necessary by blowing on it. After reaching the low temperature and forming ice on its surface, the mirror begins heating. As the temperature approaches 0°C, the instrument begins to beep, with those beeps becoming faster as the mirror gets closer to ice-melting temperature.



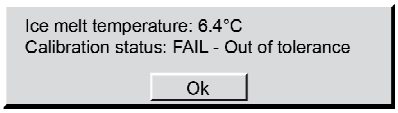
Visually observe the mirror. As soon as the mirror temperature crosses 0°C, the ice should melt into liquid water drops.



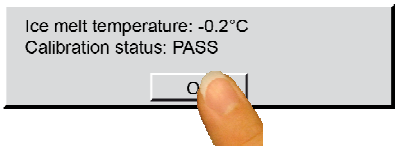
When you observe the phase transition on the mirror, press the ***Ok*** button. The mirror temperature is measured at that moment and a dialog box appears with the test results.



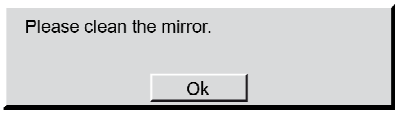
If the measured ice-melt temperature was in the range of +/- 0.2°C, the check is successful and will be indicated with the calibration status ***PASS***.



If the measured ice-melt temperature was outside the range of +/- 0.2°C, the check was not successful and will be indicated with the calibration status ***FAIL***. In this case the ice test should be repeated. If it continues to fail, the instrument should be sent to the manufacturer or an authorized agent for evaluation and/or repair.



Press the ***Ok*** button on the ***PASS/FAIL*** status window.



The next window requests you to clean the mirror.

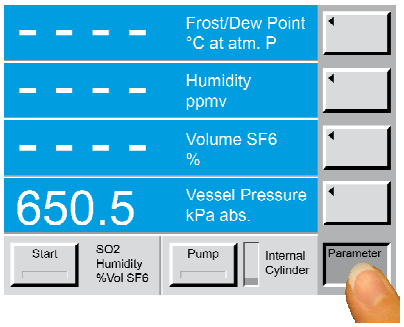
Clean the mirror with a clean cotton bud or lint free tissue. More detailed mirror cleaning information is available on page 43.

Install the optical head while observing the guide pin and up arrow. Close the measuring head with the screw cover. More detailed information is available on page 43.

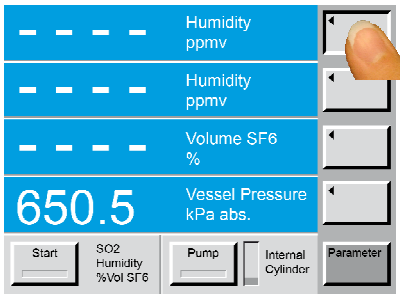
Additional Functions

Selection of the Indicated Parameters

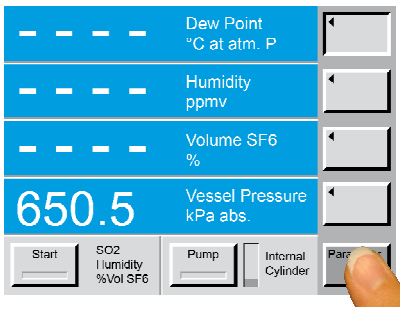
Selecting which parameter to display on the four data lines is easy. It is done with the ***Parameter*** menu.



Press the lower right menu key a couple of times to select the ***Parameter*** menu. Notice that each of the upper keys correspond to the data lines they point toward.



Press the arrow key corresponding to the data line you wish to change. Notice that each time you press the arrow key, the parameter of the data line changes. The parameter selection is circular, meaning that once you reach beyond the last available parameter, the first one is again displayed and the cycle starts over. Change the parameters on any of the other three data lines with the same method.

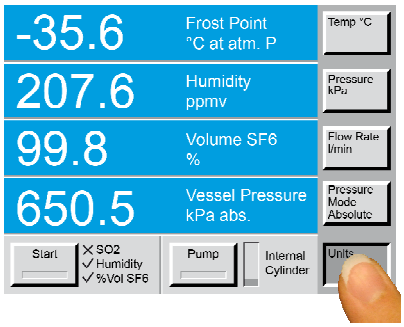


If you like, you may clear the menu keys when finished by cycling through all the menus using the lower right key on the touch screen, or more easily by pressing the ***Enter*** key once. Note that this is not required and nothing is wrong with leaving the ***Parameter*** menu (or any other menu) on the screen.

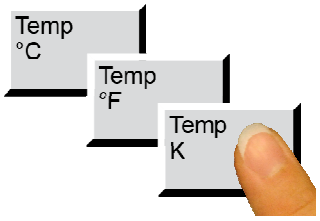
The changed selection of the ***Parameter*** menu remains displayed as long as the 973 is in operation. After restart of the 973, the display is set back to the standard configuration. Both the parameters of the instrument and those of the Excel Protocol are independent of each other and must separately be selected.

Selection of Units

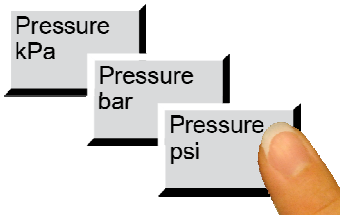
The data may be viewed in any of the many available units.



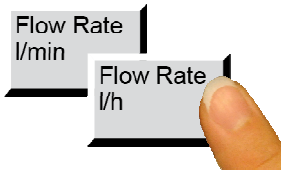
Use the lower right menu key to select the ***Units*** menu. ***Units*** appears on the key and the keys above show the various units. Notice that each of the keys shows different types of units. Unlike the ***Parameter*** menu, the keys do not correspond to the data lines, but rather to different unit types.

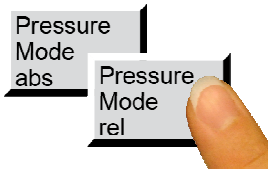


To change temperature units, press the key labeled ***Temp***. Notice that the corresponding unit changes each time the key is pressed. Also notice that any data line that is currently indicating temperature data also changes to the new unit.



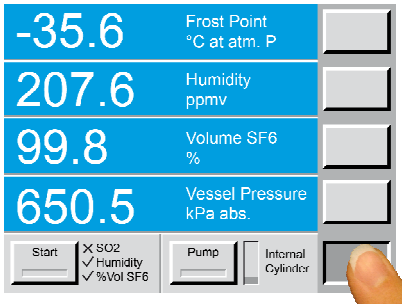
Change other units such as ***Pressure***, ***Flow Rate***, etc. with the same method.





In addition to setting the ***Pressure*** units, the mode may be set to either absolute or relative mode.

Note: Relative mode is often referred to as ‘gauge mode’ or ‘over-pressure’.



If you like, you may clear the menu keys when finished by cycling through all the menus using the lower right key on the touch screen, or by pressing the ***Enter*** key once. Note that this is not required and nothing is wrong with leaving the ***Units*** menu (or any other menu) on the screen.

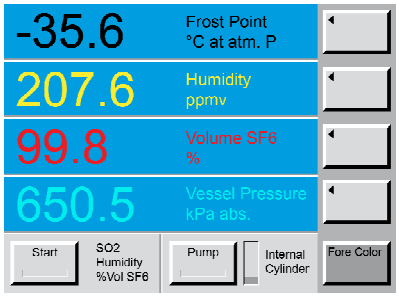
The changed units remain displayed as long as the instrument is in operation. After restart of the instrument, the display is set back to the standard configuration. Both the units of the instrument and those of the Excel Protocol are independent of each other and must separately be selected.

Changing Color

You are free to change the foreground and/or background color of any data line with the ***Fore Color*** and ***Back Color*** menus. Access the ***Fore Color*** and ***Back Color*** menus with the menu selection key. To revert to the standard system default color scheme, press and hold the 9 key for a few seconds (see page 39).

Fore Color

Fore color affects the color of number and letters.To change a data line's fore color:



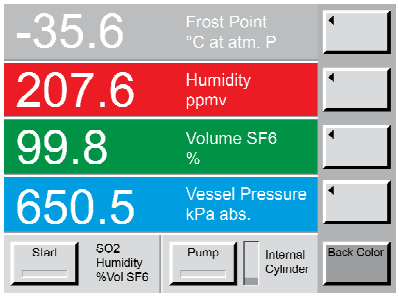
Access the ***Fore Color*** menu. ***Fore Color*** appears on the key, and the keys above contain left pointing arrows. Notice that each of the upper keys correspond to the data lines they point toward.

Press the arrow key corresponding to the data line you wish to change. Notice that the fore color of the data line changes with each press of the key.

Change the fore color on any of the other data lines with the same method.

Back Color

Back color affects the background color of number and letters. To change a data line's back color:



Access the ***Back Color*** menu. ***Back Color*** appears on the key, and the keys above contain left pointing arrows. Notice that each of the upper keys correspond to the data lines they point toward.

Press the arrow key corresponding to the data line you wish to change. Notice that the back color of the data line changes with each press of the key.

Change the back color on any of the other data lines with the same method.

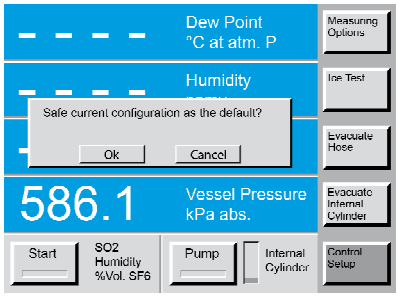
The changed selections of the ***Fore Color*** and ***Back Color*** menus remain displayed as long as the 973 is in operation. After restart of the 973 the display is set back to the standard configuration.

Storage of the Actual Settings

The 973 is delivered with a standard configuration. Options you change during normal use are not saved and the instrument reverts to its default settings after cycling the power.You may, however,store your current configuration settings as the power-up default for this instrument. Save your customized configuration as the default with the following:

Press and hold the number ***1*** on the keypad for about 5 seconds.

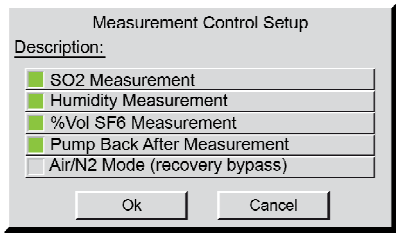
You hear a beep and a window appears asking for confirmation to store the current configuration as the new default.

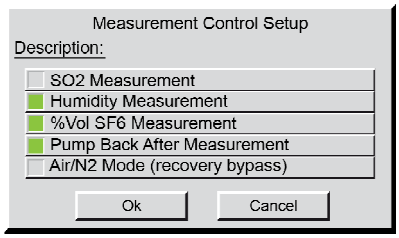


By pressing the ***Ok*** button, the current instrument settings will be stored as the new default configuration.

By pressing the ***Cancel*** button the default settings remain unaltered. The system will revert to its stored default settings at the next power-up cycle.

The Default Configuration includes the Following Settings:

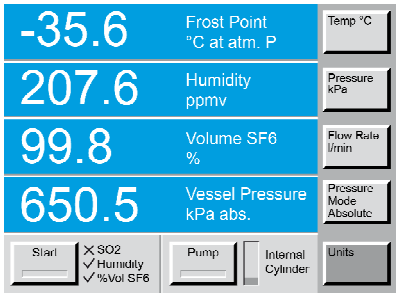




Measurement Options

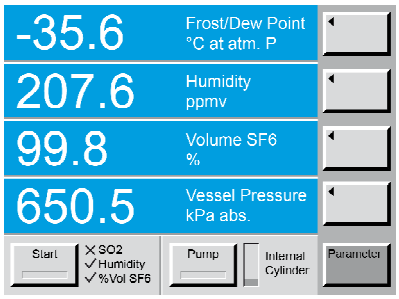
The standard configuration includes the chosen measuring options.

The first illustration displays the standard configuration for a 973 equipped with an SO_2 module. The second is for a 973 without an SO_2 module.



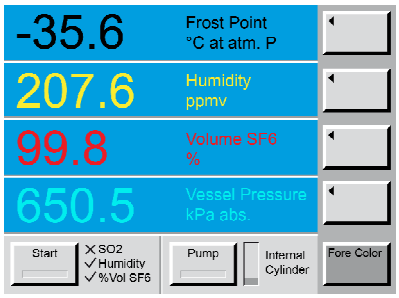
Units
abs./rel. pressure mode

The default configuration includes the units for all parameters as well as the absolute or relative pressure mode.



Parameters

The default configuration includes the parameter selection of the data lines.



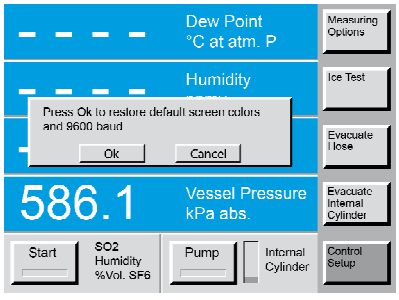
Colors

The default configuration includes the front and background colors selection.

Restore Color Settings and Baud Rate

Press and hold the number ***9*** on the keypad for about 5 seconds.

You hear a beep and a window opens.



By pressing the ***Ok*** button, the standard display color configuration and the standard baud rate 9600 are restored.

By pressing the ***Cancel,*** button the window closes without restoring the standard colors or baud rate.

Maintenance

Touch Screen Calibration

The 973 utilizes a touch screen for user interaction. To activate a menu option or toggle a function on or off, simply touch the screen directly over the key or object desired.

Before using the instrument for the first time, or when the instrument is used by different operators, you may need to calibrate the touch screen to your finger positioning preference. Left and right handed people, for example, may have different points of pressure when using the touch screen. To calibrate the touch screen, follow the instructions:

Press and hold the ***Enter*** key on the numeric keypad for 3 to 4 seconds. If you've done it correctly, you'll hear two short beeps and a key in the upper right corner will turn yellow. If not, release the ***Enter*** key and try again.

With the tip of your finger, press the center of the yellow key in the upper right corner of the touch screen. It is labeled ***Touch This Key***. Once you touch it, the yellow color goes away and another key turns yellow.

Now, touch the yellow key that's in the lower left corner of the touch screen. Once you touch it, the yellow color goes away and you have successfully calibrated the touch screen.

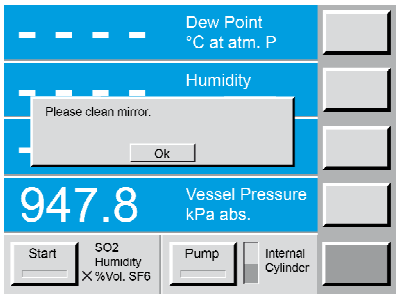
Test your new touch screen calibration by pressing the bottom right menu selection key several times. If it seems not to work well, just repeat the calibration steps again from the beginning.

You may recalibrate the touch screen as often as needed, however it is rarely required. If the touch screen does not seem to be working, please attempt to recalibrate it.

Mirror Cleaning

The heart of the 973 is the measuring head assembly. It is designed to be highly sensitive and accurate, yet rugged and easily accessible for periodic mirror cleaning. To ensure high accuracy, the mirror should be cleaned before starting a series of measurements. After removing the screw cover and the measuring head optical assembly, the mirror is easy accessible.

Request for Mirror Cleaning



If the 973 detects that a mirror cleaning is necessary after completion of a measurement, you will hear a beep and a window will open with a request to clean the mirror.

Removing the Measuring Head Cover

The measuring head is located on the right side of the 973 front panel. To gain access to the mirror and opto-electronic components, you must first remove the screw cover.

The cover looks like a large tan colored knurled knob. To remove it, simply twist it counterclockwise. It requires approximately three full turns to completely unscrew, allowing you to remove it.

Removing the Optical Assembly

Once the screw cover has been removed, the black optical assembly (optical head) is now removed by pulling it straight toward you.

Inspecting / Cleaning the Mirror

Clean the mirror with a clean cotton swab or lint free tissue.

Notice:

- **Never attempt to polish the mirror.**
- **If needed, the mirror may also be cleaned with methanol or alcohol. Always follow the use of these cleaning chemicals with distilled water to ensure they are completely rinsed from the mirror surface.**

Reassemble the Mirror Components

Up Arrow

Reassemble the mirror components in the reverse order of disassembly.

1. Install the optical assembly, taking note of the guide pin. Ensure that the arrow is pointing upward toward the top of the unit.
2. Replace the screw cover. Hand tighten until snug. Do not over tighten.

Exterior Cleaning

Front Panel

The 973 front panel is completely sealed and easily cleaned with liquid glass cleaner or other mild cleaning chemicals moistened on a cloth. Clean the front panel periodically as needed.

Specifications

Specifications	973-SF_6			
Measuring range:				
Frost/Dew Point	-50…+20 °C			
Humidity content by volume	40…20'000 ppm_v			
Humidity content by weight	5…2'500 ppm_w			
Volume SF_6	80…100%			
Inlet pressure	100…1'000 kPa abs.			
Accuracy:				
Frost/Dew Point	± 0.5 °C			
ppm_v/ ppm_w	± 1 ppm +6% of reading			
Volume SF_6	± 0.5%			
Pressure	± 3 kPa			
Standard Features:				
Digital I/O	RS-232			
Thermoelectric mirror cooling	3-stage			
Mirror temperature sensor	RTD (Pt-100)			
LCD display with touch screen	5.7"			
Internal gas tubes	Stainless Steel 316L / FEP			
Gas connections	Quick connect fitting (Swagelok® QM Series)			
Couplings	Dilo DN8 (VK/F-02/8) and DN20 (VK/F-02/20)			
External sample gas tube	6 m stainless steel armored PTFE tubing			
ORIS	**O**ptimum **R**esponse **I**njection **S**ystem			
Transport Case	Custom fit foam lined Peli 1620			
Power Cable	2.5 m			
Operating instructions	English, French or German			
Calibration certificate	Pressure calibration, 2-point dew/frost point, 3-point volume %SF_6			
Optional:				
Internal SO_2-Module	Range:	0…100 ppm_v	or	0…500 ppm_v
	Linearity:	< 2 % of range		< 2% of range
	Sensitivity drift:	< 4% / year		< 2% / month
	Response time:	< 30 s (0 to 20 ppm_v)		T_{90} < 20s
Additional Information:				
Supply voltage	100-120 VAC / 200-240 VAC, 50/60 Hz (auto switching)			
Supply voltage fluctuations	up to ± 10% of nominal voltage / Overvoltage category II Rated pollution degree 2			
Power consumption	200 Watt			
Pump back pressure max.	900 kPa			
Cooling	Air			
Operation Temperature	-10 °C…+40 °C			
Storage Temperature	-20 °C…+50 °C			
Humidity	Maximum relative humidity 98% RH, non-condensing			
Outdoor use	Permissible, instrument must be protected against exposure to water.			
Altitude	Up to 2'000 m			
Weights & Dimensions:	**Instrument**		**with Transport Case**	
Width	420 mm		650 mm	
Height	155 mm		370 mm	
Depth	390 mm		510 mm	
Weight	16.5 kg		32 kg	

We reserve the right to change design or technical data without notice.